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Soil gas Rn monitoring at Chã das Caldeiras prior the 2014-15 Fogo eruption, Cape Verde

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Since 2007 the ITER-INVOLCAN/UNICV-OVCV/SNPC research team has implemented a geochemical program for the volcanic surveillance of Fogo volcano by means of applying different geochemical methods in a regularly basis (diffuse degassing surveys, fumarole gas sampling, etc.). This program was improved by setting up a geochemical permanent station (CHA01) to perform continuous measurements of soil gas radon (222Rn) and thoron (220Rn) activities at Chã das Caldeiras, more specific in Portela village, since April 20, 2013. Both gases are characterized to ascend towards the surface mainly through cracks or faults via diffusion and/or advection mechanisms dependent of both soil porosity and permeability, which in turn vary as a function of the stress/strain changes at depth. Measurements of 222Rn and 220Rn activities were performed by an alpha-spectrometer after pumping the soil gas from a thermally isolated PVC pipe inserted 1m in the ground. Even though during the study period the recorded data did not show high 222Rn activity values, a change in the temporal evolution of soil gas 222Rn activity was observed. During the first six months, from April to October, 2013, recorded time series of 222Rn and 220Rn activities showed normal background levels with values of 80.5 and 55.2 Bqm-3, respectively. However, from October, 2013, to February, 2014, 222Rn time series showed an increase trend reaching peak values of 396 Bqm-3 and having an average activity of 134 Bqm-3 until the removal of the station on November 25, 2014 due to the potential danger of being destroyed by the lava flows. The observed increase in the soil gas 222Rn activity from October 2013 to February 2014 occurs almost at the same time of slight observed changes in the vertical displacements detected by the geodetic network installed at the Fogo Island by the ITER-INVOLCAN/UNICV-OVCV/SNPC/Nagoya University research team. Since seismic data are not available, we cannot conclude if the observed changes in soil gas 222Rn activity were originated from fracturing of rock and/or from direct magma degassing. The positive temporal correlation between 222Rn/220Rn ratio and 222Rn activity supports the hypothesis that soil 222Rn activity variations acted as a long-term precursory signal of the volcanic unrest. These results show that monitoring soil gas 222Rn, together with other geochemical and geophysical data, can be a useful monitoring tool to detect early warning signals of magma pressurization.